

# Student timesheets can aid in curriculum coordination

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## Abstract

For many years lecturers have been encouraging students to complete timesheets to help them manage their time and prepare them for the process when they enter the workforce. As well as aiding the students in time management, the data contained in a timesheet can be used for curriculum planning. In 2004, 2005, and 2006 students used a web-based timesheet system during a capstone project course. After considering the accuracy of the timesheet data the focus of this paper is an analysis of the data from the timesheet system to identify student's behavioural patterns and concludes that students work to deadlines, that students do not spend too much time on a capstone project, that the time spent on a task relates to the marks allocated to that task, that more time available for a task does not mean more time is used and that students can be induced to do tasks early.

**Keywords:** PSP, Timesheets, Capstone Projects

## 1 Introduction

Humphrey (1997) defined the Personal Software Process (PSP) to help software engineers manage their time and to estimate the duration of future tasks based on historical data collected. PSP is also a useful tool for students and lecturers to quantitatively evaluate the effort associated with a given learning experience (von Konsky, Ivins, Robey 2005).

Software Engineering Project (SEP) is a capstone program provided by the School of Computing at the University of Tasmania. Students work in teams of 4 or 5 students and collaborate with a real industry client to produce a major piece of software. SEP is a 26-week program offered on two campuses divided into two consecutive 13-week units; the students get two grades. Each semester the students produce a release of the software.

During the first semester, each team has to submit two design reports: design report 1 contains the analysis documents for the entire project; and design report 2 contains the design documents for release 1 (e.g. UML

diagrams and Prototyping). In the second half of the first semester, each team implements release 1 which is about a third of the final software product. At the end of the semester, students give a formal presentation to demonstrate their software to the client and staff.

At the beginning of the second semester, each team has to complete another design report containing the changed analysis documents and the new design documents for release 2. The major outcome for second semester is the implementation of release 2 which is around two thirds of the final product. The students also write a user manual and a reference manual. At the end of semester, students demonstrate their software at a public demonstration day.

SEP utilises the ideas of time management from the Personal Software Process defined by Humphrey (1997). Students enrolled in this unit are required to submit their weekly timesheets in order to demonstrate and improve their use of time. Logging actual effort helps students to understand how they are spending their time, where their time is wasted and how it can be used more efficiently (von Konsky et al 2005). The timesheet system uses a web-to-database model that was developed in 2004, prior to that it was paper-based. The evolution of the timesheet system is described in Clark, Davies and Skeers (2005).

For each time entry students have to enter the date they did the job, the start time and the finish time of the job, and the job code (see Figure 1). Students also record the total duration of any interruptions and a detailed description of the job. Students can make entries for a week at any time during the week and students can modify or delete the current week entries. Students are permitted to add timesheet entries for previous weeks, but they can not edit or delete entries from a previous week, as timesheet entries are used for assessment. The job codes have varied slightly over the three years. The 2006 job codes were design, implementation, prototyping, manuals, meeting, marketing, testing, study, and admin.

Since 1998 the students have been required to complete weekly timesheets. Similar to Carrington (1998) student reaction to paper timesheets was mostly negative, they saw them as pointless and many openly stated their records were not accurate, but participated because it was a requirement. In a survey conducted in 2002 only 55% of the students thought the timesheets were useful.

2004 saw the introduction of an online version of the timesheets. The online system improved the accuracy as peer pressure had an impact. In the program feedback survey conducted during 2004, 68% of students indicated that their time recordings were 90% accurate, and a further 27% thought they were 70% accurate. Over 90%

Date	Start (hh:mm)	Finish (hh:mm)	Interruptions (mins)	Job code	Comments
Mon 07 Aug ▾	09:15	11:10		Meeting ▾	Team Meeting
Mon 07 Aug ▾	14:30	15:30		Design ▾	Wrote RTM
Tue 08 Aug ▾	12:00	15:00	35	Design ▾	UML Diagrams
Wed 09 Aug ▾	09:15	09:45		Admin ▾	Worked on scheduler
Wed 09 Aug ▾	15:40	18:50	65	Prototyping ▾	Author Info screen

**Figure 1 Timesheet System Screenshot**

of students found it useful to see how much time they were spending on their project and over 85% of students found it useful to see where their team members were spending their time. This represented a marked change in attitude to the value of monitoring time.

The timesheets are worth 5% of the final grade each semester. Each weekly timesheet is worth 0.5% of the final grade. To get the 0.5% they must enter a minimum number of entries (5 in 2005) for that week and they must average over 8 hours per week over the entire semester or for each week they average less than 8 hours they get 0. The students do 13 timesheets each semester and the 3 with the lowest score are not counted – allowing students to have weeks where they can do minimal project work. Each timesheet is due Monday midnight of the following week. For example, week 1 timesheet entries are due on midnight Monday of week 2. Any entries added after that time are not counted towards the number of entries for that week but are counted towards the average time.

The data in the timesheets is also used to do assessment of their work products. For example, the amount of time an individual spends on design is used in the calculation of their individual mark for a design report. Late entries count towards their assessment for a work product (up to the assessment date). Clark (2005) describes how timesheet data is used in the assessment process.

The timesheet entry data, which was collected from 2004, 2005 and semester 1, 2006, was first analysed for accuracy and then analysed to identify student's behavioural patterns and provide answers to the following research questions:

- Do students work to deadlines?
- Do students spend too much time on a capstone project?
- Does time spent on a task relate to the marks allocated to that task?
- Does more time available for a task mean more time is used?
- Can we induce students to do tasks early?

## 2 How accurate are the timesheets?

For timesheets to produce meaningful data they need to be accurate. Johnson and Disney (1998) found that using PSP in both industrial and academic settings revealed problems both in collection of data and its later analysis.

In SEP missing entries were believed to be common. As shown in Table 1 the average number of timesheet entries per student per week reduced slightly from 2004 to 2005 but rose in 2006. In 2006 the lecturer really emphasised the importance of timesheets and told students, 'if it is not on your timesheet you didn't do it', and explained the negative impact this would have on their assessment (equivalent of working in the real world for no pay).

To analyse the missing entries problem further students were divided into different groups according to their average weekly timesheet entries, shown in Table 2. In 2004, the first year of use of the electronic system, the lecturer had not established a minimum number of entries that they should enter each week for assessment purposes. It is interesting that this year had the greatest percentage of students entering more than 10 entries a week. However, the lecturer told students in 2005 that they had to make at least 4 timesheet entries each week to gain the 0.5% for that week's timesheet. As a result, the percentage of students who made less than 6 entries per week increased from 11% to 21%. In particular, the proportion of students who just entered 4 to 5 timesheet entries on average each week increased from 2% in 2004 to 9% in 2005. In 2006 this negative impact has been combated by changing the minimum requirement to 5 entries each week and waging the "if its not on your timesheet" campaign. The proportion of students who entered the minimum requirement or below reduced from 9% in 2005 to 6% in 2006. The campaign also increased the number of timesheet entries made, reducing the number of missing entries and therefore increasing their accuracy. In 2004 and 2005 69% of students averaged more than 7 entries, but in 2006 this number has increased to 79%. This analysis indicates that the majority of students are recording enough data for the timesheets to be useful for further analysis.

	2004	2005	Semester 1, 2006
Number of teams	27	25	24
Number of students	129	118	115
Total hours	40860	35109	18192
Average hours per student per week	12.18	11.44	12.17
Number of entries	29498	25385	13338
Average entries per student per week	8.79	8.27	8.92

**Table 1 Summary of timesheet data**

	2004	2005	Semester 1, 2006
4-5 entries	2%	9%	1%
5-6 entries	9%	12%	5%
6-7 entries	20%	10%	15%
7-8 entries	16%	21%	21%
8-9 entries	13%	15%	25%
9-10 entries	11%	9%	12%
>10 entries	29%	24%	21%

**Table 2 Average weekly timesheet entries**

In SEP because team members can see other team member's entries there is very little problem with fictitious or overly exaggerated entries. In general students do so much work on the project that fictitious entries are not necessary, the bigger problem is missing entries. Team members are asked to provide feedback to the lecturer via peer assessment every 4 weeks about whether they believe team member's entries are accurate. Timesheets are also discussed at the team management meetings with the lecturer every 3 weeks, and any dubious timesheet entries are discussed and corrected. Timesheets have been used in the program for over 8 years and the lecturer has enough experience to know which timesheet entries are abnormal. Imbalances between the amount of work submitted and what is recorded in the personal contribution reports and the timesheets provide a mechanism for ensuring minimal fictitious or overly exaggerated entries. 'Rounding up' of time taken is very common as students tend to record things as starting and ending on the hour. To minimise the impact of this for assessment, ratios (percent of total time) or ranges (10-12 hours) are used rather than exact Figures such as 10 hours per week. There is no evidence to suggest that using timesheet entries for assessment or increasing the number of required entries has increased the number of fictitious or exaggerated entries and that the data collected is useful enough for further analysis.

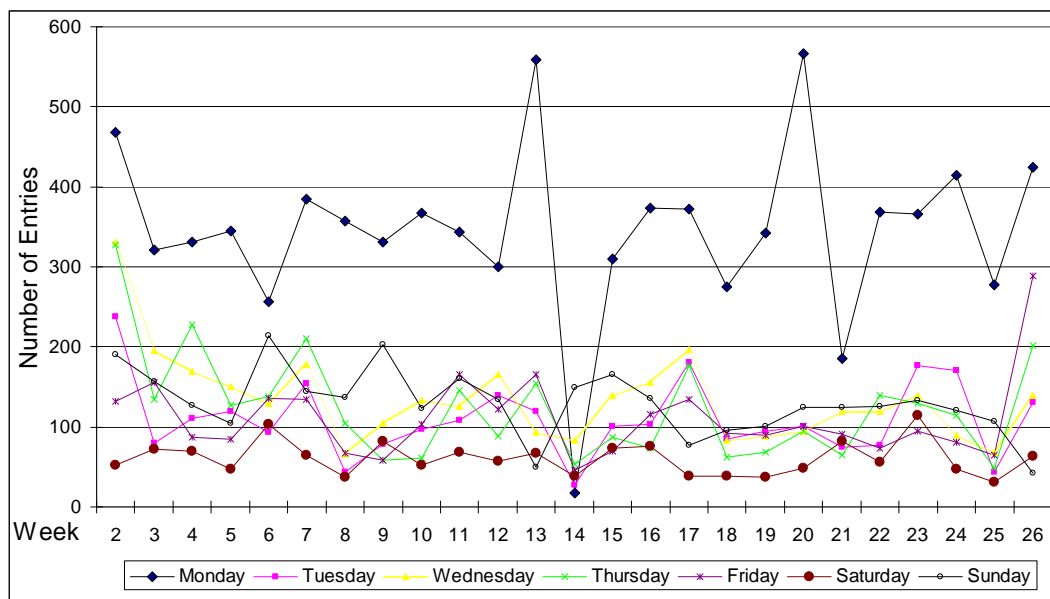
### 3 Do students work to deadlines?

It is strongly suspected that student's do the majority of their assignments when they are due, this is based on anecdotal evidence such as overflowing computer labs and the number of questioning students queuing at the door. Mathews, Haughton, Pisupati, Scaroni, DiBiase (2004) analysed how often their students accessed online data and found that most of the accesses were performed on the day of the deadline.

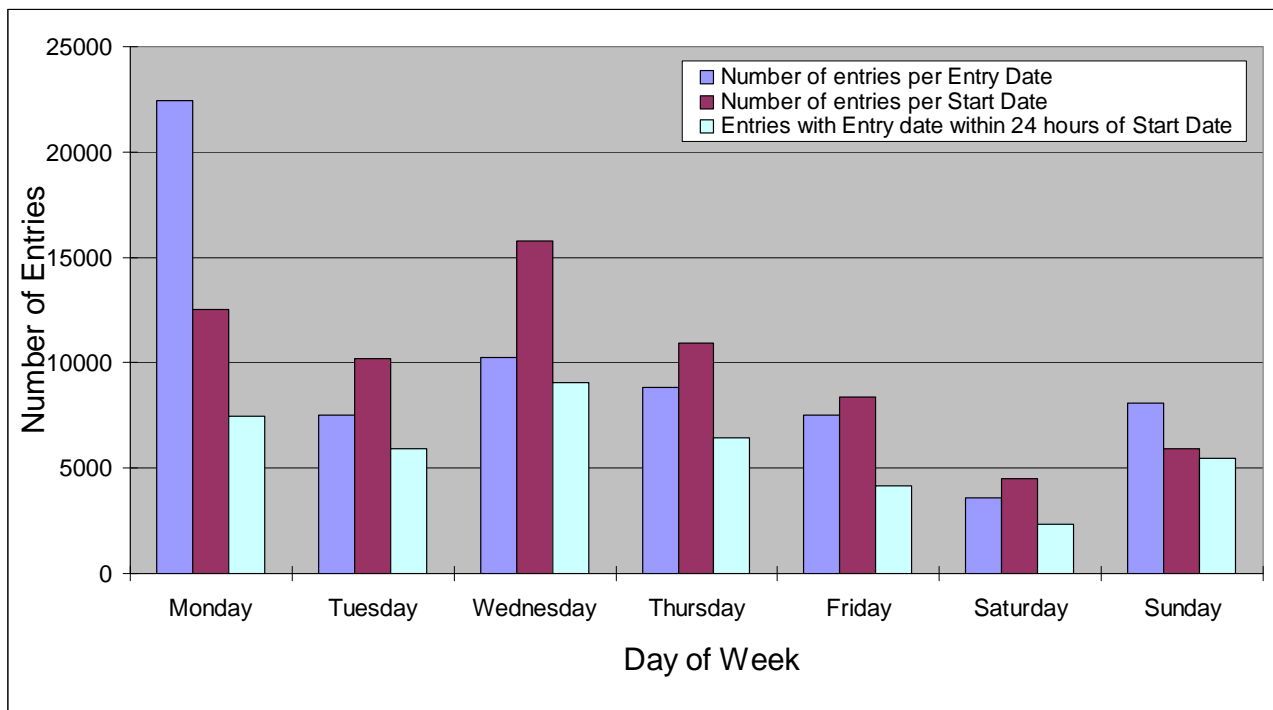
To confirm this for project students timesheet data was analysed for peak activity times. Figure 2 shows the number of timesheet entries entered on each week day for each week in 2005. The graphs for 2004 and semester 1, 2006 are very similar. In all years Monday was the day of the week when students entered the most number of timesheet entries, except for week 14. The timesheet entries were due on Monday midnight for the previous week. Week 14 was the first week of the second semester and students had just recommenced their project so Monday of week 14 was not a due date. In contrast, the day of week with the least number of timesheet entries was Saturday in all years.

Figure 3 shows the amalgamated data from all three years for the number of entries per entry day, the number of entries per start date (the day the work was done), and the number of entries that were entered within 24 hours of doing the work. There were almost three times as many entries made on Monday than the other days. On every day, except Monday and Sunday, the number of entries made was less than the amount of work started on that day. Only about 50% of entries were entered within 24 hours of doing the work, except on Sundays. This is because when students worked on Sunday, they had to submit it within 24 hours (or it would be a late entry and not count towards timesheet assessment).

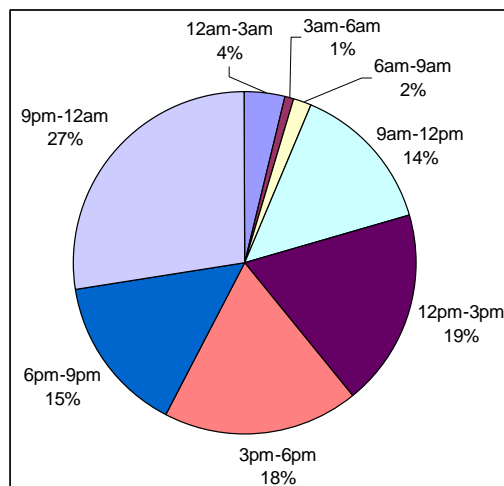
To further analyse when students actually submitted their times, the due date was divided into eight 3-hour time slots and the timesheet entries proportion for each slot was analysed, shown in Figure 4.



**Figure 2 Number of timesheet entries on each day for each week in 2005**



**Figure 3 Timesheet entries on each week day**



**Figure 4 Proportion of timesheet entries for each 3 hour period on Monday**

The biggest proportion of entries was made during 9pm to midnight. Indicating students submit their entries at the last minute, literally.

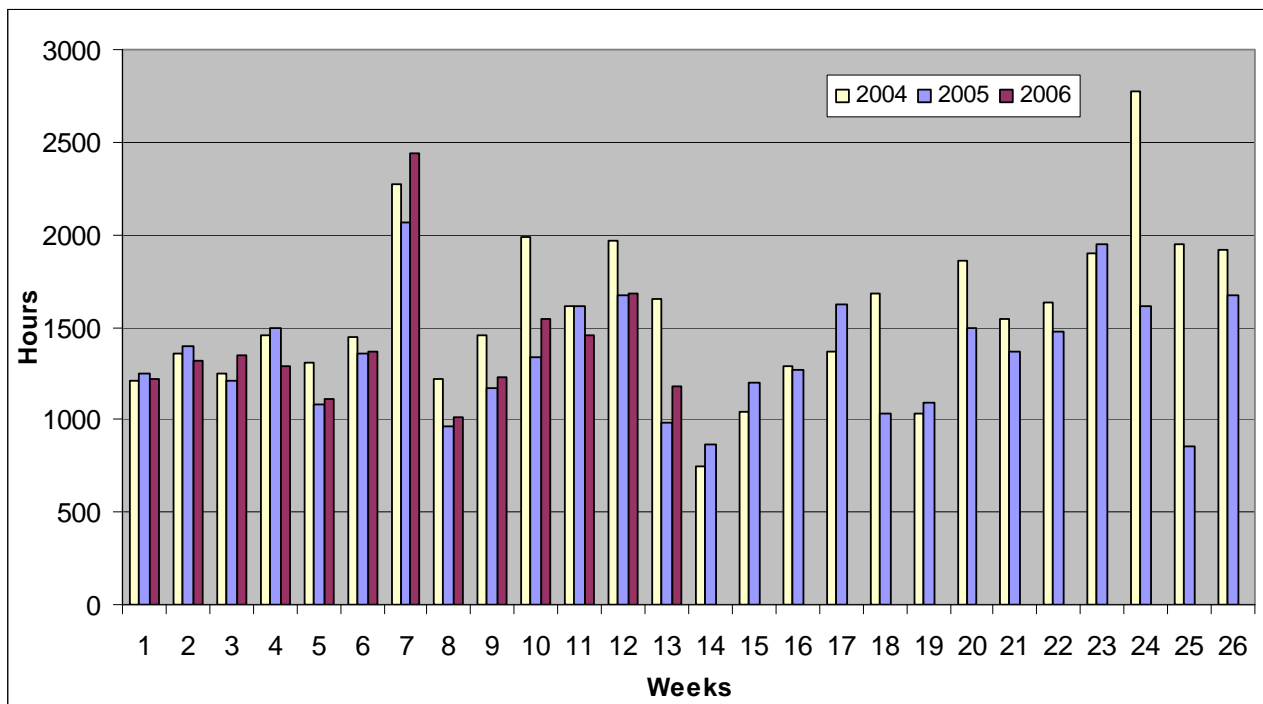
This evidence suggests that students are not recording their times as they do the work. Anecdotal evidence suggests that the students are recording their times on a “paper” timesheet judging by the fact that the blank paper timesheets that are available are continually disappearing and a ‘show of hands’ survey taken during a lecture. Obviously, further research needs to be conducted to confirm how many people are actually writing down their times at the time they do the work. To encourage students to do their entries earlier, next year we are considering introducing the rule that a timesheet entry only counts towards assessment of the timesheet if it was entered within 24 hours of doing the work – daily deadlines!

Figure 5 shows the amount of time that was spent on the project on a week by week basis, and there are some obvious peaks. Week 7 is obviously a very busy week in all years (this is the week design report 2 is due). Other key weeks are weeks 17/18 (design report 3), week 23 in 2005 (demonstration day was in week 24), week 24 in 2004 (demonstration day was in week 25) and week 26 in both years (the software is assessed and manuals are due).

All this evidence confirms what lecturers have known anecdotally for a long time – students do the majority of work for a task close to the deadline.

#### **4 Do students spend too much time on a capstone project?**

It is extremely common that when students are doing a capstone project that they focus all their attention on the project to the detriment of their other subjects. Lecturers of capstone projects can suffer the ire of their colleagues who say their subjects are suffering as a result of students putting most of their time into the capstone project. When students use PSP, lecturers can evaluate just how much time the students are actually using (von Konsky et al 2005). As shown in Table 1, students averaged 12.18 hours on the project per week in 2004, compared to 11.44 hours in 2005. There were several possible reasons for this reduction. Firstly, the lecturer warned the students during lectures and meetings to reduce the time they spent on the project, particularly students who were averaging more than 15 hours a week. Secondly, there were changes made to the assessment procedures requiring less work to be completed, see Clark (2005) for more details. In 2006, the average was 12.17 hours per student. One reason for this increase was that the average weekly entries increased above the 2004 level, as discussed in the previous section.



**Figure 5 Summary of hours per week**

Students are told that to pass they must spend at least 8 hours a week on average on the project. The University advises students to spend 10 hours a week on each unit. The analysis indicates that over the three years students are averaging around 12 hours a week on project, leaving plenty of time for their other units or commitments. Similar to Carrington's (1998) results some of the overload reported by students can be attributed to poor time management skills.

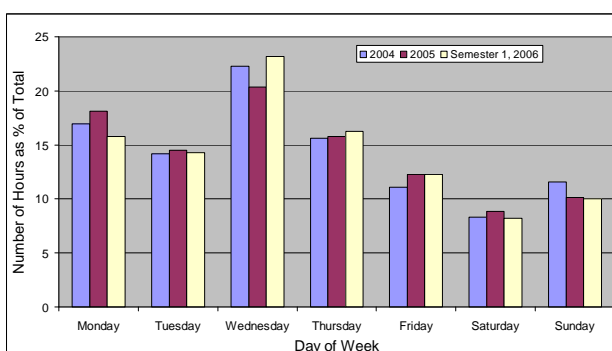
The day that most work was undertaken was Wednesday with Monday being the second busiest day, as shown in Figure 6. The reason for more work being completed on Mondays and Wednesdays was that these are the "project days" for each campus. The computer labs are reserved in the morning and the lectures are occasionally scheduled in the afternoons. When there is no lecture students are encouraged to work on their project. Classes for other final year School of Computing units are not scheduled on these days. This indicates that students are using the time set aside to do the project work. Other weekdays do

contain a substantial amount of project work but in contrast, the amount of work undertaken on Saturdays was the least in all years. This is possibly a result of the change in student lifestyle. Many students are now working as well as studying, making it difficult for a team to get together on the weekend.

As already seen from Figure 5 students work to deadlines resulting in key weeks where there are peaks of project activity. It is likely that these weeks coincide with the submission week for assignments in other subjects, particularly week 7 as this is the middle of a semester. Complaints from colleagues and students are probably based on student availability in a given week. Based on this data it is obvious that if lecturers cooperated and organised it so other units had their submissions due in the week after a key project week it is likely that there would be less complaints.

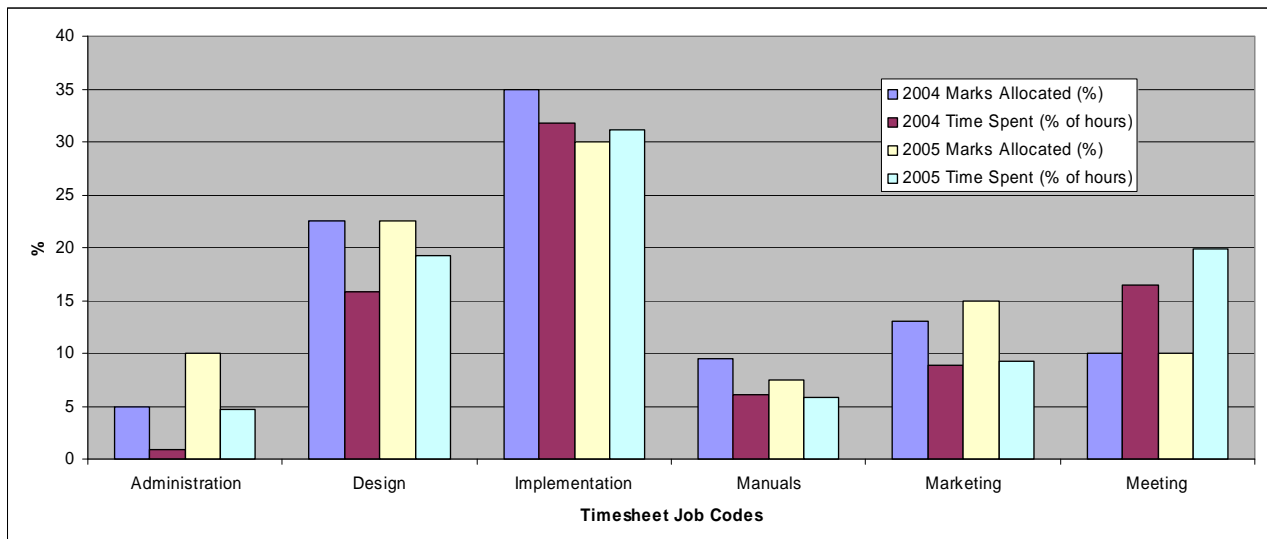
## 5 Does time spent on a task relate to the marks allocated for that task?

Most units involve assessment, for many it is a combination of an exam and some assignments. How much each assignment should be weighted is a difficult decision. Generally the decision is made based on how long it will take for the student to do one assignment in comparison to another or how much time is available for one assignment versus another. Von Konsky et al (2005) conducted a study using PSP data to quantitatively evaluate effort against learning outcomes and adjusted the curriculum accordingly. The PSP data was analysed to see if there was a correlation between how much time students spent on each of the assessed components and the marks allocated for that component.



**Figure 6 Summary of hours on each week day**





**Figure 7 Time spent versus marks allocated in 2004**

Figure 7 shows the percentage of the marks allocated for a component versus the percentage of time students spent on that component during 2004 and 2005. For the purposes of this analysis the time spent and marks allocated have been combined for the two semesters in a year, but the assessment is performed on a semester basis. Clark (2005) describes the entire assessment process. Design, implementation and meetings were the most time-consuming jobs in all years.

Some job codes have a direct assessment component (e.g. design and implementation) but some others do not. Meetings are not assessed, but individuals get marks for professionalism at team meetings (assessed by peers) and professionalism at client meetings (assessed by client). Administration is also not assessed, but timesheets (in both years) and using the task scheduler and completing a diary (in 2005) all formed part of the administration job code.

The time spent was very similar to the marks allocated. In the majority of cases the differences did not exceed 7%. In particular, the difference for implementation was just 3% in 2004 and 1% in 2005. This is interesting because student often comment that the software should be worth more of the final grade!

One possible reason for any discrepancy is the job code "study" (researching project management process) which was not allocated marks, occupied 9-10% of the time consumption. Much of this time would have been spent on study that resulted in improved design and implementation marks. This is confirmed when each semester is looked at in isolation as the amount of time spent on study in semester 2 has decreased by 50% on semester 1 each year and the design and the implementation times are much closer to the marks allocated. The reason for the sharp decrease was that the number of lectures was halved in semester 2 and that students are more familiar with the project management process so they spend less time reading project management materials.

Another reason for any discrepancy is meeting time spent was more than what was allocated by marks for professionalism but many meetings were held to deal with design and implementation issues as stated in the comment field of the time entry.

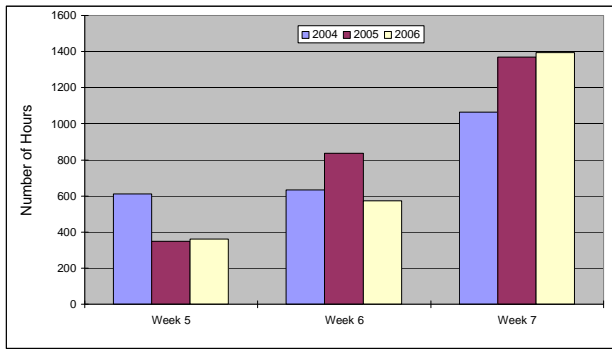
So having the PSP data is an excellent way of confirming that the distribution of marks is closely related to the time spent on an assessed task, rather than using the less meaningful time available statistic. PSP data is also useful for making educated adjustments. For example, based on the accumulated data, the weighting for many components does not need to change but the weighting for marketing and administration should be reduced or these tasks should be made to involve more work.

The correlation between marks and time spent could also explain why students spend so much time on project tasks in comparison to other assignments as they are generally worth more to a final grade. In the School of Computing the average assignment weighting for an assignment for final year students is 12.5%, ranging from 5-25%. Based on this analysis students are going to devote more time to a 30% implementation mark rather than a 5% assignment.

## 6 Does more time available for a task mean more time is used?

When lecturers set an assignment it is always an issue deciding how much time to allow. We are faced with the dilemma that it takes time to come to terms with the problem, to learn the required skills and then perform the task. Unfortunately, as already shown, the majority of students will leave the task until it is due or shortly before.

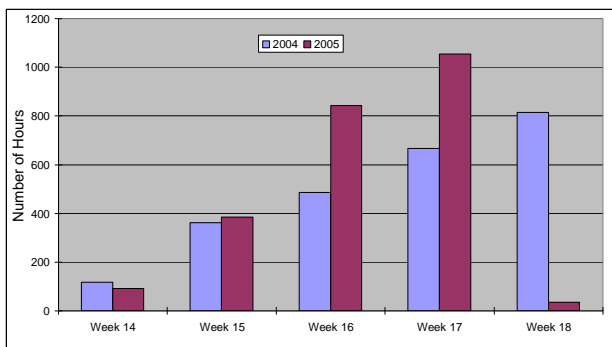
One interesting event during the design report 2 phase (weeks 5 to 7) is the impact of the Easter break – which means students have two weeks in real time but it is only counted as one project week. In 2004, week 7 (the week it was due) was the Easter break week and compared to week 5 and week 6, the design time almost doubled, as shown in Figure 8. In 2005 the Easter break week was week 5 (the first week in the design process), however, in



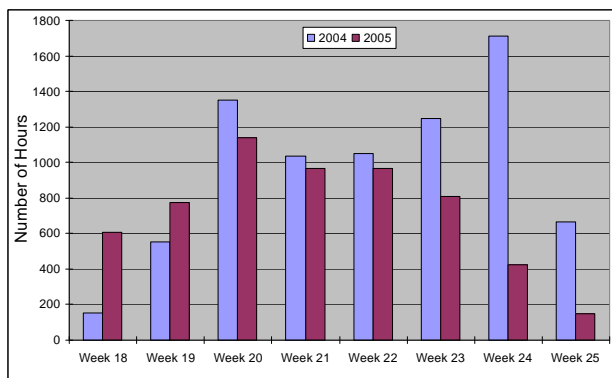
**Figure 8 Design time from week 5 to 7**

comparison to other years students spent the least time on design during this week. The Easter break week was back to week 7 in 2006, and again the amount of design work doubled in this week. From this one can only conclude that students do the most work in the week it is due and that the extra time does not result in more time used.

In semester 2, students start design report 3 in week 14. In 2004, students had 5 weeks but in 2005 they only had 4 weeks to finish the design report, as shown in Figure 9. In 2005 the average hours spent on design was 593 hours per week, much higher than the 489 average hours per week in 2004. In 2005 118 students spent a total of 2371 hours doing design (20 hours per student) and in 2004 when they had an extra week 129 students spent 2445 hours (19 hours per student). In both years the students did the most work in the week it was due, but more time meant that the load was more evenly spread over the allowed weeks, whereas the shorter time resulted in more dramatic increases each week.



**Figure 9 Design Time from week 14 to 18**



**Figure 10 Implementation time from week 18 to 25**

Release 2 was completed from week 18 to week 25, Figure 10 shows the implementation time for 2004 and 2005. At the end of semester there is a public demonstration of the final software for clients and members of the Tasmanian IT community. In 2004, the demonstration day was in week 25 and the peak of the implementation time was achieved in week 24. Another peak of the implementation time was reached in week 20 (the semester 2 mid-semester break, two weeks in real time). The time spent on implementation was more evenly spread in 2005 and the peak appeared in week 20 which was again the mid-semester break week, but this peak does not indicate that significantly more work was completed this week, as the other weeks are all very similar.

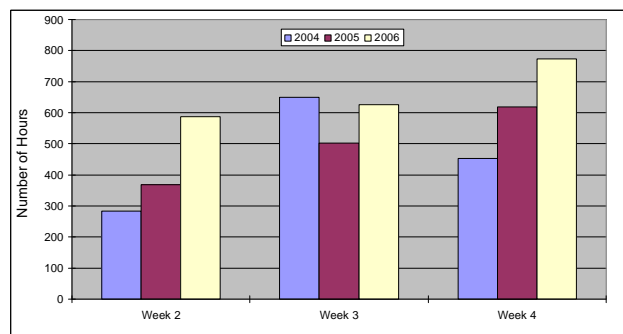
This analysis shows that making more time available does not mean that more time will be used, and that most work is completed near when the task is due. This suggests that when setting assignments it would be better to give each assignment a short available time and coordinate across subjects to ensure minimal overlap.

## 7 Can we induce students to do tasks early?

Most lecturers are concerned that students appear to leave their assignment work until it is due, this is one of the reasons that PSP is included. They would like to find a way to encourage students to spread the load over the allocated time, not only to increase their learning but to distribute the use of the available resources (e.g. computer labs). The data was analysed to see what events resulted in students doing tasks early.

Each project is tested at various times during the semester by people other than members of the development team. Each student enrolled is required to develop one project and test three other projects at different times during a semester. All teams are developing different projects, so there are no concerns about plagiarism. The testing process was assessed but the actual items made available for testing were not assessed by the lecturer until after the development team had fixed them based on feedback from the testers – see Clark (2004) for more details.

After students have a client meeting to acquire requirements in week 1, they write the analysis documents (design report 1). As shown in Figure 11, the first peaks of time spent on design in all three years were achieved around week 3 or week 4 because students had to submit their design report in week 4.

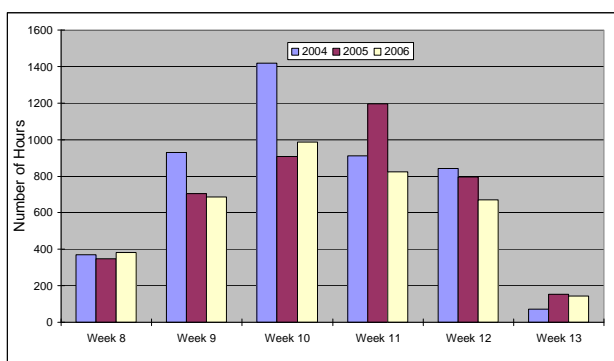


**Figure 11 Design time spent from Week 2 to 4**

In 2004, the peak of the design time in these three weeks was in week 3. One reason was students were required to distribute two of the documents from design report 1 to their testers by the end of week 3 to be tested early in week 4. In week 4, they modified these documents according to the feedback they received and completed two more documents. In 2005, students were not required to send the documents in week 3 and could have their testing meeting anytime in week 4. Thus, the design time rose linearly from week 2 to week 4 this year. The situation changed in 2006, students had to hold their testing session in week 3 but they only had to test one document. The time spent on design was much higher than the previous two years in week 2 and the design time spent in weeks 2 and 3 was almost the same.

Figure 12 shows the implementation time from week 8 to week 13 when the students were implementing release 1. There were two testing sessions held in week 11 and week 12 in 2004 and the peak of the time spent on implementation was reached in week 10. In 2005, only one testing session was held in week 12 and the peak of the time spent on implementation was moved to week 11. In 2006, students held one testing session either in week 11 or in week 12 and the peak was in week 10, but it was much more evenly spread from weeks 9 to 12.

This analysis indicates that students can be induced to do work prior to a deadline by introducing some pseudo earlier deadlines (even just getting them to distribute the work to fellow students).



**Figure 12 Implementation time from Week 8 to 13**

## 8 Conclusion

The timesheet data was considered accurate enough to do some meaningful analysis and this analysis has identified common student behavioural patterns which most lecturers knew to be true based on anecdotal evidence: students do work close to deadlines, students will do the minimum requirements for assessment unless encouraged by the assessment system to do otherwise, students will focus their attention to areas that have the most marks associated with them.

Students do not spend too much time on a capstone project, but they do spend more time on projects than their other subjects, possibly because it has more deadlines or possibly because the assessed components are worth more than the assignments in other subjects.

The time spent on a task does relate to the marks allocated to that task. PSP data could be used to tweak an assessment weighting to ensure the marks are distributed where the students are spending the most effort (time) rather than using a weighting based on time available. To get students to put more effort into their assignments they should be weighted higher (and if necessary made to include more work to justify the weighting).

Giving the students more time to complete an assignment does not mean more time will be used to complete the assignment. The most work will be completed close to the deadline though students can be induced to do work early if there are marks associated with doing it early. When assignments are set they should be given minimal available time but coordination across subjects must ensure minimal overlap and deadlines should avoid key weeks in the project process.

In conclusion, collating PSP data over a three year period has provided some meaningful insights into student behaviour and these insights could be very useful for curriculum coordination.

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